EVALUATION OF CURRENT WATER SUPPLIES
TEXAS STATE SENATE BILL 1
REGION B

3.1 Existing Surface Water Supply

To evaluate the adequacy of supply from existing reservoirs in Region B, a review of the 1997 State Water Plan, previous water planning studies and historical operations were conducted. In addition, projected sedimentation in the reservoirs over the planning period (2000 – 2050) was evaluated. This information was used to assess the current firm yields of the reservoirs. Summaries of the 1997 State Water Plan data and the proposed reservoir yields based on this review are presented in Tables 3-1 and 3-2, respectively. For reservoirs whose reported firm yields could not be verified through previous studies, operation studies were conducted provided the data was available. The adequacy of supply for Greenbelt Lake was evaluated by Region A, and the findings are presented in this memorandum. The sedimentation analysis is discussed in Section 3.1.2.

3.1.1 Existing Water Supply Reservoirs

Greenbelt Lake

Greenbelt Lake is located in Region A, but water from the lake is used to supply several cities in Region B. The lake is owned and operated by the Greenbelt Municipal and Industrial Water Authority, and is located on the Salt Fork of the Red River in Donley County near the City of Clarendon. Construction of Greenbelt Lake was completed in 1968, and the lake had an initial conservation capacity of 60,400 acre-feet. Greenbelt Municipal and Industrial Water Authority has a diversion right of 12,000 acre-feet per year from the lake to provide municipal, industrial, mining and irrigation water supply. The firm yield of the reservoir in year 2000 is estimated to be 7,699 acre-feet per year.

Table 3-1: Summary of 1997 State Water Plan Yield Studies

Reservoir	County	Elev	1997 State Water Plan			Uses	Operation Study			Critical Period		Drought of Record	Comments
		(MSL)	Area (acres)	Capacity (ac-ft)	Yield (af/yr)		Date	Author	Period of Record	Dates	Length (years)		
Lake Pauline	Hardeman	NA	NA	NA	3,000	Industrial	NA	NA	NA	NA	NA	NA	TWDB estimates the yield from Lake Pauline/Groesbeck Creek to be 3,000 AF/Y.
Lake Kemp	Baylor	1144	15,590	268,000	116,000	Municipal	1976	F&N	1949-1974	6/42-6/45	3	6/42 – 5/47	1973 capacity listed; yield based on 2020 capacity.
Lake Diversion	Archer, Baylor	1051	3,419	40,000	1,100	Industrial	1976	F&N	1949-1974	Firm yield was not determined			Original capacity; operation study evaluated required make-up from Lake Kemp to maintain elevation
Santa Rosa Lake	Wilbarger	NA	NA	NA	NA	Irrigation	1967	F&N	NA	10/55-2/57	1.3	NA	TWDB does not include lake in 1997 Water Plan. TWDB yield estimates of 3000 ac-ft/yr are based on operation studies conducted as part of Red River Master Plan (F&N, 1967).
Lake Electra	Wilbarger	1110	600	8,050	600	Municipal	NA	NA	NA	NA	NA	NA	TWDB yield is based on water right.
N.F. Buffalo Crk Reservoir	Wichita	1048	1,500	15,400	840	Municipal	NA	NA	NA	NA	NA	NA	TWDB yield is based on water right.
Lake Kickapoo	Archer	1045	6,200	106,000	16,072	Municipal	1997	TWDB	1940-1989	5/58 – 9/80	32.3	5/58 – 5/82	Original area-capacity. Yield does not account for sedimentation.
Lake Arrowhead	Clay, Archer	926	16,200	262,100	29,532	Municipal	1997	TWDB	1940-1989	5/58 – 9/80	32.3	5/58 – 5/82	Original area-capacity. Yield reflects 2050 sediment conditions.
Lake Olney/ Cooper	Archer	NA	NA	6,650	1,260	Municipal	NA	NA	NA	NA	NA	NA	TWDB yield is based on water right.
Lake Nocona	Montague	827	NA	NA	4,500	Municipal/ Rec/Ind	NA	NA	NA	NA	NA	NA	TWDB yield is based on original water right.
Lake Amon Carter	Montague	920	1,848	28,589	2,600	Municipal	1979	HDR	1941-1970	6/51 – 1/57	5.5	6/51 – 5/57	1980 area-capacity data, yield reflects 2000 capacity.

NA – Not Available

Table 3-2: Updated Reservoir Yields for Region B

Reservoir	County	Elev	Year 2000			Uses	Operation Study			Critical Period		Drought of Record	Comments
		(MSL)	Area (acres)	Capacity (ac-ft)	Yield (af/yr)		Date	Author	Period of Record	Dates	Length (years)		
Lake Pauline	Hardeman	1490	543	3,297	1,800	Industrial	1999	F&N	1962-1982	10/69 – 2/71	1.3	10/69 – 10/71	Lake yield with Groesbeck Crk diversion
Lake Kemp	Baylor	1144	12,475	204,000	126,000	Municipal	1976	F&N	1949-1974	6/42-6/45	3	6/42 – 8/49	Yield reflects year 2000 sediment conditions.
Lake Diversion	Archer, Baylor	1051	3,282	30,100	0	Industrial	1976	F&N	1949-1974	Firm yield was not determined			Operation study indicated Diversion required make-up from Lake Kemp to maintain elevation
Santa Rosa	Wilbarger	NA	NA	6,980	0	Irrigation							Yield estimate based on historical performance
Lake Electra	Wilbarger	1111	731	5,626	470	Municipal	1999	F&N	1940 - 1997	10/41 – 11/54	13.1	10/41 – 12/97	Area-capacity data updated in 1998. Reservoir most likely has never spilled. Separate study by Electra's consultant (DGRA) found similar yield.
N.F. Buffalo Crk Reservoir	Wichita	1048	1,500	14,378	2,100	Municipal	1999	F&N	1940 - 1997	7/58 – 2/81	22.5	7/58 – 6/87	Little change in yield through the planning period due to long critical period.
Kickapoo	Archer	1045	6,072	96,302	15,946	Municipal	1999	F&N	1940-1989	5/58 – 8/80	22.3	5/58 – 5/82	Revised yield to account for sedimentation.
Lake Arrowhead	Clay, Archer	926	14,000	246,800	29,532	Municipal	1997	TWDB	1940-1989	5/58 – 9/80	22.3	5/58 – 5/82	Yield reflects year 2050 sediment conditions. Year 2000 analysis was not conducted by TWDB.
Lake Olney/ Cooper	Archer	1150	465	6,165	910	Municipal	1999	F&N	1940 - 1997	7/58 – 9/84	26.2	7/58 – 5/90	Projected little change in yield due to long critical period.
Lake Nocona	Montague	827	1,413	21,750	1,260	Municipal/ Rec/Ind	1986	F&N	1940-1984	6/51-1/57	5.5	6/51-5/57	1986 area-capacity data. Projected little change in yield over planning period.
Lake Amon Carter	Montague	920	1,848	27,559	2,600	Municipal	1979	HDR	1941-1970	6/51 – 1/57	5.5	6/51 – 5/57	Yield study conducted for 1980 and 2030. 2000 yield interpolated.

NA – Not Available

Lake Pauline

Lake Pauline is located on the upper reaches of Wanderers Creek near Quanah in Hardeman County. The dam was completed in 1928 and the reservoir had a reported conservation capacity of 4,137 acre-feet in 1968 (Bisset, 1999). Lake Pauline is owned and operated by West Texas Utilities Company. Its primary use is for cooling water for the Lake Pauline power plant. The lake is permitted for 7,137 acre-feet per year, which includes 3,000 acre-feet per year of diversions from Groesbeck Creek. The power plant at Lake Pauline is used to meet peak demands during the summer and winter months. As a result the water use from the lake varies with power demands. For the years 1994 through 1996, the reported water use from Lake Pauline was less than 5 acre-feet per year. The use for 1998 was reported as 119 acre-feet.

Previous yield studies for Lake Pauline/Groesbeck Creek were not available. The TWDB projects the yield of Lake Pauline and Groesbeck Creek to be approximately 3,000 acre-feet per year. The sedimentation analysis predicts the capacity of the reservoir to be about 1,850 acre-feet in 2050. With such a small capacity, it is unlikely that Lake Pauline alone can support a yield of 3,000 acre-feet per year. Therefore, a yield study of Lake Pauline with Groesbeck Creek diversions was conducted for the period of record from 1962 through 1982 (which was the available period for flows in Groesbeck Creek). Since flows in Groesbeck Creek are influenced by mining activities west of Quanah, flows into Lake Pauline were developed from drainage area ratios with the North Wichita River in Foard County. Flows from Groesbeck Creek were diverted to Lake Pauline to maintain the conservation storage. Limitations to the diversions included a maximum diversion rate (56 cfs), maximum yearly diversion (3,000 acre-feet) and the total flow in the river. Minimum flows were not considered. Based on the 1971 and projected 2050 area capacities of the lake, the yield of the Lake Pauline/ Groesbeck Creek system was determined to be 1,983 and 1,532 acre-feet per year, respectively. The estimated firm yield for year 2000 is 1,800 acre-feet per year.

Lakes Kemp and Diversion

Lake Kemp is located on the Wichita River, immediately upstream of State Highway 183 in Baylor County. The original storage was estimated at 268,000 acre-feet. Lake Diversion was

constructed approximately 20 miles downstream of Lake Kemp for secondary storage. The reservoir lies in both Archer and Baylor counties, and has a capacity of 40,000 acre-feet.

Lake Diversion is operated in conjunction with Lake Kemp to provide water supply for municipal, industrial, irrigation, mining and recreational purposes. The City of Wichita Falls and Wichita County Improvement District No. 2 own both Lake Kemp and Lake Diversion. Water released from Lake Kemp travels to Lake Diversion for distribution. Irrigation water is diverted into canal systems.

Due to high salinity loads in the tributaries that flow to Lake Kemp, the use of water from Lake Kemp is limited. Most of the water from the Lake Kemp-Lake Diversion system is used for irrigation. To improve the water quality of the Wichita River, the Red River Authority sponsored the construction of a chloride control project, Truscott Brine Reservoir, that diverts saline water from the South Wichita River above Lake Kemp. Recent evaluations of the effectiveness of the project found these diversions reduce the total chloride load to Lake Kemp by approximately 25 percent. This results in a lower flow-weighted chloride concentration in the reservoir. However, there still is a significant chloride load to the reservoir system from the North and Middle Wichita Rivers. Future proposed diversions from these tributaries should further reduce the chloride loading into Lake Kemp.

The yield of Lake Kemp was most recently evaluated in 1976 (F&N, 1976). The yield reported in the 1997 State Water Plan was based on this study using the year 2020 area-capacity data. Assuming the average sedimentation rate determined from the 1973 sedimentation survey (1.13 acre-feet/ square mile of drainage area) continues over the planning period, the projected yield of Lake Kemp in 2050 is 101,540 acre-feet per year.

Lake Diversion, while considered secondary storage for Lake Kemp, actually may be a demand on Lake Kemp supplies during a drought. Water is supplied from Lake Kemp to maintain the water elevation in Lake Diversion. Under its current operation, it is assumed that Lake Diversion has no firm yield and is not a water supply source for this regional plan.

Santa Rosa Lake

Santa Rosa Lake is located in Wilbarger County on Beaver Creek. It was constructed in 1929 by Waggoner Estate for irrigation and had an original capacity of 15,755 acre-feet. Current use is for livestock and irrigation. It is permitted for 3,075 acre-feet per year, but recent historical use is much lower. According to a representative of Waggoner Estate, the lake went totally dry in 1971.

Based on the sedimentation analysis, the projected capacity of Santa Rosa Lake in 2050 is reduced to about 800 acre-feet due to the lake's large drainage area. Recent reported use from the lake is less than 70 acre-feet per year. The reported use when the lake purportedly went dry was not available, but was most likely less than the permitted use. In light of these findings, Santa Rosa Lake has little to no reliable supply, and is not considered a water supply source for planning purposes.

Lake Electra

Lake Electra is located on Camp Creek near the City of Electra in Wichita County. It is owned and operated by the City of Electra and has a diversion right of 600 acre-feet per year for municipal use. At normal pool elevation (1,111 feet MSL), the storage capacity of Lake Electra is 5,626 acre-feet. However, due to the relatively small drainage area (14.5 square miles), the lake often does not operate at normal pool elevation. Previous reports indicate the lake may never have completely filled since construction was completed in 1950.

Lake Electra is currently experiencing low lake levels and may be in a critical drought. A recent study conducted by DGRA for the City of Electra found that the firm yield of the lake is approximately 460 acre-feet per year. This analysis was based on the 1998 area-capacity survey, using inflows developed for a period of record from 1950 to 1970. To confirm these findings, a separate yield study was conducted as part of this evaluation for the period of record from 1940 to 1997. Inflows were based on a rainfall-runoff relationship developed from Lake Kirby for Lake Electra (F&N, 1948). This study found the firm yield of Lake Electra to be 470 acre-feet per year. It also indicated that the lake might never have filled, and that Lake Electra is still in its critical drought. Data received from the City's consultant indicate water levels for the lake have continued to decline in 1998 and 1999. It is possible that Lake Electra is entering another critical

period and further study should be conducted to confirm the lake's yield. For this plan, it is assumed that the firm yield of Lake Electra is 470 acre-feet per year.

To supplement Lake Electra, the City has a permit to divert up to 800 acre-feet per year from Beaver Creek for emergency municipal use. This right has been used on occasion, but there is no permanent diversion structure or transmission line. A review of available flows in Beaver Creek indicates that during some years there is very little flow during the hot dry months. In 1984, the total flow during the dry spring and summer months was less than 800 acre-feet. Also, Beaver Creek has a higher salinity level than Lake Electra. Large diversions from Beaver Creek may require additional treatment, which is currently undesirable. During a drought, diversions from Beaver Creek will be minimal because of the water quality and low flow conditions. To fully utilize this emergency right, diversions from Beaver Creek must be planned over the year. Assuming this occurs and water is diverted at the allowable rate of 1.3 cfs, it is estimated that 550 acre-feet per year of supply is available from Beaver Creek during a dry year. However, since there is no existing diversion system in place, it is assumed that this supply is currently not available to Electra.

North Fork Buffalo Creek Reservoir

The North Fork Buffalo Creek Reservoir was constructed in 1964 to provide additional water for the City of Iowa Park. The dam is located below the confluence of North Fork Buffalo Creek and Lost Creek in Wichita County. The reservoir had an original storage capacity of 15,400 acre-feet with a drainage area of 33 square miles. The current permitted water right for the reservoir is 840 acre-feet per year. North Fork Buffalo Creek Reservoir is owned and operated by the City of Iowa Park.

The yield reported in the 1997 State Water Plan for North Fork Buffalo Creek Reservoir is the water right amount. The initial yield study of the reservoir was conducted in 1961 for a larger lake with historical flows through 1959 (BMI, 1961). Subsequent yield studies of North Fork Buffalo Creek Reservoir were not available. As part of this plan, a yield study was conducted for the reservoir for the period of 1940 through 1997. Since there was no available USGS gage in the North Fork Buffalo Creek watershed, historical flows were developed from the City of

Archer gage (1940 – 1961) and Beaver Creek (1962 – 1997) based on drainage area ratios. The yield of the reservoir was found to be 2,100 acre-feet per year throughout the planning period. There was little difference in yields between years 2000 and 2050 due to the long critical period and relative small reduction in capacity from sedimentation.

Wichita System

The Wichita System consists of Lake Kickapoo and Lake Arrowhead. These lakes are owned and operated by the City of Wichita Falls for municipal and industrial supply. Water from the lakes is transported to Wichita Falls' water treatment plants for treatment and distribution. Some raw water is sold directly to wholesale customers. A brief description of each lake follows:

Lake Kickapoo

Lake Kickapoo was built by the City of Wichita Falls in 1946 for municipal water supply with an initial conservation storage capacity of 106,000 acre-feet. The reservoir is located on the North Fork of the Little Wichita River in Archer County. It is owned and operated by the City of Wichita Falls. The diversion rights from the lake total 41,720 acre-feet per year. Recent reservoir operation analyses for Lake Kickapoo conducted by the TWDB reported the firm yield to be 16,072 acre-feet per year with an estimated conservation storage of 105,000. The TWDB analysis did not take into account sedimentation. Therefore, the long-term yield of Lake Kickapoo was re-analyzed. The results of these analyses indicated only a minimal decrease in reservoir yield over the planning period. This was attributed to the long critical period (1958 - 1982). The projected yields of Lake Kickapoo in years 2000 and 2050 are 15,945 and 15,343 acre-feet per year, respectively. The revised yields are used in the assessment of supply.

Lake Arrowhead

Lake Arrowhead was built in 1966 by the City of Wichita Falls for municipal, industrial and recreational use. The lake is located on Little Wichita River in Clay County, about 12 miles southeast of Wichita Falls. The lake is owned and operated by the City of Wichita Falls. The diversion rights from Lake Arrowhead are over 45,000 acre-feet per year. This reservoir was recently evaluated by TWDB (1997) in conjunction with Lake Kickapoo. Accounting for

sedimentation, the yield of Lake Arrowhead in 2050 was reported to be 29,532 acre-feet per year, with a 2050 projected conservation storage of 224,241acre-feet.

Lakes Olney and Cooper

Lakes Olney and Cooper are a twin-lake system located on Mesquite Creek in Archer County. Lake Olney dam was constructed in 1935 to provide municipal water for the City of Olney. In 1953 the dam for Lake Cooper was built for additional storage. Collectively, the lakes have a conservation storage capacity of 6,650 acre-feet, with diversion rights of 1,260 acre-feet per year.

The yield reported for these lakes in the 1997 State Water Plan is based on the water right. Previous yield studies were not available for review. Since the lakes have a small drainage area (12.3 square miles) that may not be able to support the full diversion right, estimates of the firm yield of Lakes Olney and Cooper for years 2000 and 2050 were determined. Inflows were developed from the Archer City and Beaver Creek gages, and area-capacity relationships were estimated assuming a trapezoidal shape. The firm yield of the lakes was determined to be 910 acre-feet per year. This yield remains constant through the planning period due to the long critical period (26.2 years) and small amount of sedimentation.

Lake Nocona

Lake Nocona is a 25,400 acre-foot reservoir located on Farmers Creek in Montague County, approximately 8 miles northeast of the City of Nocona. Construction was completed in 1960 to provide municipal water supply to the City of Nocona. The lake is owned and operated by the North Montague County Water Supply District. The original permit for Lake Nocona allowed the diversion and use of 4,500 acre-feet per year for municipal, industrial, and mining purposes. In 1984, the final determination of water rights for the Middle Red River segment of the Red River Basin reduced the authorized diversion to 645 acre-feet per year for municipal use only. Subsequent studies reported the firm yield of the reservoir to be 1,260 acre-feet per year through year 2030 (F&N, 1986). The water right permit for diversions from Lake Nocona was amended in 1987 to 1,260 acre-feet per year for municipal, irrigation and recreational uses.

The 1986 study found that sedimentation is not expected to significantly affect the firm yield of Lake Nocona over the planning period. The yield analyses conducted in 1986 assumed 1986 area-capacity conditions and accounted for reduced inflows from Soil Conservation Services (SCS) structures. It was assumed that over time, the impact of the SCS structures on runoff would decrease as the sediment pools become silted. This would result in an increase of inflows over the critical period, which would negate the reduction in yield due to future sedimentation. The study concluded that the firm yield of Lake Nocona should be approximately 1,260 acre-feet per year through 2030. For this plan it is assumed that the firm yield remains constant through the planning period.

Amon G. Carter

Lake Amon G. Carter is located on Big Sandy Creek in Montague County, about 6 miles south of the City of Bowie, Texas. The lake was originally constructed in 1956 and enlarged in 1979. It has a current storage capacity of 28,600 acre-feet and an estimated yield of 2,600 acre-feet per year. The lake is owned and operated by the City of Bowie for water supply. The existing water right permit allows for a diversion of 5,000 acre-feet per year for municipal, industrial and mining water use.

Lake Amon Carter's yield reported by TWDB is based on year 2000 capacity. Operation studies using year 2030 area-capacity data indicate a reduction in yield of just over 100 acre-feet per year (2,488 acre-feet per year). Additional sedimentation may continue to slightly reduce the firm yield of this reservoir, but it should not be significant. For this study, the 2050 firm yield of Lake Amon Carter was estimated at 2,413 acre-feet per year.

Miller's Creek Reservoir

Miller's Creek Reservoir is located about 7 miles southeast of Bomarton, Texas. The dam was constructed in 1977 on Miller's Creek in Baylor County, and the reservoir extends southwest into Throckmorton County. It is owned and operated by the North Central Texas MWA. It has a permitted diversion of 5,000 acre-feet per year for municipal, industrial and mining uses. Since water from this reservoir is primarily used for municipal supply for cities located in Knox and

Haskell Counties in Region G, this reservoir will not be further considered in the Region B analyses.

Other Lakes and Reservoirs in the Region

Lake Wichita

Lake Wichita is located south of the City of Wichita Falls and lies in Archer and Wichita county. It was constructed in 1901 on Holliday Creek for irrigation and municipal use, but little water has been used for municipal purposes since Lake Kickapoo water supply became available. This is because Lake Wichita has a very high chloride content and must be blended with higher quality water to be acceptable for municipal use. Presently, Lake Wichita is used for recreational purposes only.

Lake Iowa Park

Lake Iowa Park is located on Stevens Creek, northwest of the City of Iowa Park, and has been a source of water for the City of Iowa Park since 1949. The lake has a storage capacity of 2,565 acre-feet and the water right permit allows a diversion of 500 acre-feet per year for municipal use. It is currently used in conjunction with North Fork Buffalo Creek for supply to the City of Iowa Park. No yield studies were conducted for this lake. For this plan, it is assumed that half of the water right is available for supply.

3.1.2 Sedimentation and Reservoir Yields

Sediment production rates in Region B vary considerably due to land use, soil types and topography. Wind erosion is quite active across the rolling prairies and cultivated fields. The USGS and U.S. Soil Conservation Services have compiled much of the sedimentation data available for reservoirs in Region B. Only Lake Kemp, Santa Rosa Lake, Lake Amon Carter and Lake Nocona have published sedimentation surveys. Therefore, for this study estimates of sedimentation rates were developed from several sources. For sedimentation rates developed from the Texas Board of Water Engineers Report 5912, the effects of SCS structures and development were considered. Estimates of reservoir capacities for years 2000 and 2050, based

on the reservoir's drainage area and sedimentation rate, are presented in Table 3-3. Since the yield of a reservoir is affected by the reservoir's area-capacity relationship, high sedimentation rates will reduce the reservoir's storage capacity and firm yield. The projected reservoir yields over the planning period are presented in Appendix A, Table 4.

Table 3-3: Estimated Sedimentation Rates and Projected Capacities

Reservoir	Drainage Area (Sq mi)	Sediment Rate (af/yr/sq mi)	Year Began Filling	Year of Initial Capacity	Capacities (Ac-ft)			Source (sediment rate)
					Initial	2000	2050	
Lake Pauline	42.6	0.68	1928	1971	4,137	3,297	1,849	TBWE 1959
Lake Kemp	2086	1.13	1922	1973[1]	268,000	204,356	86,500	F&N 1976
Santa Rosa Lake	334	0.37	1929	1929	15,755	6,980	802	TWC 1979
Lake Electra	14.5	0.69	1950	1998[2]	5,626	5,626	5,126	TBWE 1959
North Fork Buffalo Creek	33	0.86	1964	1964	15,400	14,378	12,959	TBWE 1959
Lake Kickapoo	275	0.68	1946	1946	106,400	96,302	86,952	TBWE 1959
Lake Arrowhead	832	0.54	1966	1966	262,100	246,800	224,240	TWDB 1997
Olney/Cooper	12.3	0.68	1935/1953	1935/1953	6,650	6,165	5,747	TBWE 1959
Lake Nocona	94	0.48	1961	1961	25,400	21,750	19,500	F&N 1986
Amon Carter	101	0.51	1956	1980[3]	28,589	27,559	24,983	HDR 1979

1. Revised construction was completed in 1973. At that time, COE re-surveyed the lake.
2. 1998 area-capacity data. Previous survey conducted in 1987 indicated much larger capacity. This difference is currently being investigated.
3. Enlargement of the Lake Amon Carter was completed in 1980 and area-capacity was determined at that time.

3.1.3 Reservoir Water Rights

Water rights for reservoirs located in Region B are summarized on Table 3-4. Comparisons of rights to firm yields indicate that water rights for many of the reservoirs in Region B exceed firm yield. For most of the reservoirs, the existing contractual demands are typically less than reservoir yields. Only for Lake Electra are the historical use and municipal sales greater than the reservoir's firm yield. For Lake Kemp, the 2000 firm yield is approximately 65 percent of the

permitted right. While historical use has not exceeded the reservoir yield, the City of Wichita Falls and Wichita County Water Improvement District No. 2 will need to develop operational policies to ensure there are sufficient supplies to the users, especially if Wichita Falls begins to use water from Lake Kemp for municipal use on a regular basis. Presently, water from Lake Kemp is used only for irrigation and industrial uses, with occasional emergency municipal use. A summary of the existing known contracts by reservoir is presented on Table 3-5. With the exception of the City of Wichita Falls, the primary water right holders are not included on Table 3-5.

Table 3-4: Summary of Reservoir Water Rights

Reservoir	Water Right No.	Holder	Water Right Amount (acre-feet/year)						2000 Yield (ac-ft/yr)
			Mun	Ind	Irr	Mining	Rec	Total	
Greenbelt	5233	Greenbelt MIWA	14,530	500	250	750		16,030	7,699
Pauline/ Groesbeck	5230	West Texas Utility Company		7,137	16		0	7,153	1,800
Kemp/ Diversion	5123	Wichita Co WID#2 Wichita Falls	25,150	40,000	120,000	2,000	5,850	193,000	126,000
Santa Rosa	5124	W.T. Waggoner Estate			3,075			3,075	0
Electra	5128 5128	City of Electra Emergency supply	600 800					1,400	400
Kickapoo	5144	Wichita Falls	40,000					40,000	15,945
Arrowhead	5150	Wichita Falls	45,000					45,000	29,532
Olney/ Cooper	5146	City of Olney	1,260					1,260	910
N.F. Buffalo Creek	5131	City of Iowa Park	840					840	2,100
Iowa Park	5132	City of Iowa Park	500					500	250[1]
Nocona	4879	North Montague Co. WSD	1,080		100		80	1,260	1,260
Amon Carter	3320	City of Bowie	3,500	1,300		200		5,000	2,600

Mun – Municipal Use Ind – Industrial Use Irr – Irrigation Use Rec – Recreational Use

1. No available yield studies. The yield was assumed to be half of the water right.

Source: Texas Natural Resource Conservation Commission, Water Rights Database, 1999.

Table 3-5: Summary of Existing Water Supply Contracts

Source Name	Contract Holder	Contract Amount		Comment
		MGD	AF/YR	
Greenbelt	Crowell		247	No Contract Amount – 1996 Historical Use
Greenbelt	Quanah		720	No Contract Amount – 1996 Historical Use
Greenbelt	Red River Authority		237	No Contract Amount – 1996 Historical Use
Greenbelt	Georgia Pacific		328	No Contract Amount – 1996 Historical Use
Kemp/Diversion	Panda Energy International	8	9,000	New Contract[1]
Kemp/Diversion	West Texas Utilities Co		20,000	Contract, Water Right No.398
Kemp/Diversion	TPW Dundee Fish Hatchery		2,200	
Nocona	Nocona Hills Owners Assoc		246	Contract, Water Right No.240
Wichita System	Archer City	0.6	673	Contract – Lake Kickapoo, Water Rt No.384
Wichita System	Archer County MUD #1	0.15	168	Contract, No Expiration Date
Wichita System	Burkburnett	2.493	2,795	Contract
Wichita System	Dean Dale WSC	0.825	925	Contract, No Expiration Date
Wichita System	Friberg-Cooper WSC	0.25	280	
Wichita System	Holliday		264	No Contract Amount – 1996 Historical Use
Wichita System	Iowa Park	1.995	2,236	
Wichita System	Lakeside City		392	
Wichita System	Olney	1	1,120	Contract – Lake Kickapoo, Water Rt No.1471
Wichita System	Pleasant Valley		78	No Contract Amount – 1996 Historical Use
Wichita System	Red River Authority	0.75	841	
Wichita System	Scotland	0.25	280	
Wichita System	Sheppard AFB	2.167	2,429	Budgeted amount. The AFB is not restricted to a maximum or minimum water supply.
Wichita System	Wichita Falls		21,650	1996 Historical Use
Wichita System	Wichita Valley WSC	0.25	280	
Wichita System	Windthorst WSC	0.75	841	

Table 3-5 (cont): Summary of Existing Water Supply Contracts

Source Name	Contract Holder	Contract Amount		Comment
		MGD	AF/YR	
Wichita System	AC Spark Plug		101	No Contract Amount - Historical Use
Wichita System	Pittsburg Plate Glass		303	No Contract Amount - Historical Use
Wichita System	Stanley Tool		95	No Contract Amount - Historical Use
Wichita System	Vetrotex America		842	No Contract Amount - Historical Use
Wichita System	Flake Ind. Serv.		106	No Contract Amount - Historical Use
Wichita System	Wichita Nat. Linen		93	No Contract Amount - Historical Use
Wichita System	Howmet Turbine		115	No Contract Amount - Historical Use
Wichita System	W F Energy		349	No Contract Amount - Historical Use
Wichita System	Howmet Refurb.		31	No Contract Amount - Historical Use
TOTAL AMOUNT – WICHITA SYSTEM			37,310	

Sources: Lehfeldt, David (City of Wichita). Communication with Simone Kiel (of Freese and Nichols, Inc.), Data as of May 1999, Received August 1999.

Kidd, Bobby (of Greenbelt Municipal and Industrial Water Authority). Communication with Simone Kiel (of Freese and Nichols, Inc.), August 1999.

Texas Natural Resource Conservation Commission, Water Rights Database, 1999.

[1] The contract with Panda Energy is for 8 MGD of water taken from the WCWID canal system, approximately 17 miles downstream of Lake Diversion. Accounting for losses during transport, the amount of water from the Kemp/Diversion system to Panda Energy is approximated at 14,000 acre-ft./yr.

3.1.4 Run-of-River Supplies

Portions of three river basins are located in Region B. The Red River and its tributaries represent the largest river system, flowing across the central and northern areas of the region. The Brazos River flows through the southern portion of King and Baylor counties, and the upper tributaries of the Trinity River lie in southwest Montague County.

The Red River forms the northern boundary of Region B and flows eastward along the Texas – Oklahoma border. Tributaries within the region include the Pease River, Wichita River and Little Wichita River. High concentrations of total dissolved solids, sulfate and chloride are concerns for the upper reaches of these streams during low flow conditions. Naturally occurring salt springs, seeps and gypsum outcrops are found in the area westward of Wichita County to the High Plains Caprock Escarpment in Region A. The quality of the water gradually improves downstream toward the eastern portion of the region. As a result water from these rivers in Cottle, Foard, King, Hardeman and parts of Baylor and Wilbarger counties is generally not used or is restricted to irrigation use only.

Existing run-of-the river water rights for the Red River system in Region B are shown on Table 3-6 and include rights on the Red River in Clay and Montague Counties, Little Wichita River, Wichita River and Beaver Creek. Beaver Creek is a tributary to the Wichita River, and flows eastward from Foard County to the Wichita River in Wichita County. Groesbeck Creek, which has a large water right associated with Lake Pauline, is addressed with this reservoir. Generally, rights associated with reservoirs, unnamed tributaries, or smaller rivers and streams are not included on Table 3-6.

Table 3-6: Run of the River Water Rights

Water Right	County	Amount (af/yr)	Use	Owner
Red River				
4877	Montague	1,600	Mining	Peba Oil & Gas
5143	Clay	200	Irrigation	Joe J. Parker
Little Wichita River				
4268	Clay	3,600	Irrigation	A.L. Rhodes
5152	Clay	1,560	Municipal	City of Henrietta
Wichita River				
4433	Wichita	300	Irrigation	Alvin & Nana Robertson
5135	Clay	357	Irrigation	Eagle Farms, Inc.
5136	Clay	200	Irrigation	Joe L. Hale Estate
5138	Clay	55	Irrigation	M.E. McBride
5139	Clay	30	Irrigation	Bob Brown
5140	Clay	270	Industrial	Red River Feed Yard, Inc.
5152A	Wichita	2,352	Recreation	City of Wichita Falls
5530	Wichita	32	Irrigation	Joe L. Burton
Beaver Creek				
5125	Wilbarger	675	Irrigation	W.T. Waggoner Estate
5126	Wilbarger	60	Municipal	W.T. Waggoner Estate
5127	Wilbarger	85	Municipal, Mining	W.T. Waggoner Estate
5129	Wichita	404	Irrigation	Harry L. Mitchell
5393	Wichita	450	Irrigation	James Brockriede
5128[1]	Wilbarger	800	Municipal	City of Electra

1. This water right is associated with Lake Electra. It is a right to divert water from Beaver Creek to Lake Electra for emergency municipal use.

Source: Texas Natural Resource Conservation Commission, Water Rights Database, 1999.

Methodology

To assess the availability of water from streams in Region B, the historical flows for the major rivers were reviewed. Many existing water rights are not limited by minimum flows for environmental protection, but future rights will be subject to minimum flow requirements. Therefore, a comparison of historical flows, water rights and future available supply was evaluated. The Lyons method, which is TNRCC's default method in the absence of specific studies, was used to determine the amount of flow that is available when minimum flows are considered (Lyons, 1979). The Lyons method recommends maintaining minimum stream flows

of 40 percent of the median flow during October through February and 60 percent of the median flow during March through September. Flows above these amounts were assumed available for supply. After accounting for in-stream flow requirements, the minimum annual flow for the period of record was selected as the available supply during drought conditions. A summary of the run-of-the-river analysis is presented in Table 3-7.

Table 3-7: Run of the River Available Supply

River	USGS Gage	Period of Record	Minimum Flow (af/yr)[1]	Available Supply (af/yr)[2]	Existing Water Rights
Red River	7308500 (near Burkburnett)	1960 – 1998	99,506	3,127	200
Red River	7315500 (Terral, OK)	1960 – 1998	449,046	112,879	1,800
Little Wichita	7314900 (above Henrietta)	1966 – 1998	1,463	902	5,160 (3,600)[3]
Wichita	7312500 (at Wichita Falls)	1960 - 1998	60,725	20,833	2,684
Wichita	7212700 (near Charlie)	1968 - 1998	101,014	35,049	3,596
Beaver Creek	7312200 (at Electra)	1960 - 1998	11,645	7,004	2,474

1. Minimum annual flow recorded during the period of record
2. Minimum flow after accounting for instream requirements.
3. Existing water rights, excluding City of Henrietta

As shown on the above table, there are sufficient flows in the Red and Wichita Rivers and Beaver Creek to support existing water rights, and there may be additional flow for potential future diversions. However, the water in these streams is high in chlorides and suspended solids, which may unsuitable for municipal use. The analysis for the Little Wichita River found there is little available flow for diversions. This is due in part to impoundment of upstream flows in Lake Arrowhead. Since the water right for the City of Henrietta has priority over both Lakes Arrowhead and Kickapoo, much of this right is supplied via Lake Arrowhead. Water is released from Lake Arrowhead and flows downstream to the City's diversion point. Currently, it does not appear that the Little Wichita River can fully support all existing water rights during a drought. Some reductions in flows for upstream water right holders may already be accounted for in the analyses. However, the reported historical use for water rights greater than 1,000 acre-feet per year indicates that many of these rights are currently not being used.

3.2 Groundwater Supplies

3.2.1 General Description

Groundwater is primarily supplied in Region B by two aquifers, the Seymour and the Blaine Gypsum. The Seymour is designated a major aquifer and is found in the central and western portions of the region. It is currently used in Hardeman, Wilbarger, Wichita, Clay, Baylor, Foard and Cottle counties. The Blaine is considered a minor aquifer and useable groundwater is limited to the westernmost portion of the region. These aquifers provide a large percentage of available supply in these counties. In addition, the upper portion of the Trinity Aquifer occurs in Montague County in the eastern part of the region. Limited quantities of groundwater are used from the Trinity for municipal and irrigation uses. There are also unconsolidated formations within the region that are used for ground water supply in some areas. The TWDB identifies these sources as "Undifferentiated Other Aquifer". These formations are not well defined in the literature, but still provide substantial quantities of water in Archer, Clay, Cottle, Montague and Wichita Counties. For purposes of this report, the ground water availability for "Other Aquifers" will be determined from the reported historical use.

Seymour Aquifer

The Seymour Formation consists of isolated areas of alluvium that vary in saturated thickness from less than 10 feet to over 80 feet. This aquifer is relatively shallow and exists under water table conditions in most of its extent. Artesian conditions can occur where the water-bearing zone is overlain by clay. The upper portion of the Seymour consists of fine-grained and cemented sediments. The basal portion of the formation has greater permeability and produces greater volumes of water. Yields of wells typically range from 100 gpm to 1,300 gpm, depending on the saturated thickness, and average about 300 gpm.

Recharge to the Seymour is largely due to direct infiltration of precipitation over the outcrop area. Surface streams adjoining the outcrop are at elevations lower than the water levels in the Seymour aquifer and do not contribute to recharge. Other possible sources of recharge include

infiltration from irrigation or upward leakage of water from underlying Permian formations, but these amounts are insignificant.

Natural discharge from the Seymour occurs through seeps and springs, evapotranspiration, and leakage to the Permian. Harden estimates that a large part of the Seymour's total natural discharge is from evapotranspiration from plants and is considerably larger than discharges to seeps and springs (TWDB Report 337, 1992).

Water quality of the Seymour is variable throughout the region, and generally ranges from fresh to slightly saline. Brine pollution from earlier oil activities and excessive pumping has caused localized concentrations of minerals in the alluvium, limiting the full utilization of the water resource. In addition, high nitrate concentrations occur in the ground water over a wide area. These nitrate concentrations are often due to agricultural practices, and can be attributed to nitrogen fertilizer or leaching from areas formerly covered by nitrogen fixing vegetation such as grasses or mesquite groves. Other sources of nitrate include organic matter from poorly functioning septic systems, infiltration of animal wastes or naturally occurring sources.

Blaine Aquifer

The Blaine Formation extends in a narrow outcrop band from Wheeler to King counties. Groundwater occurs in numerous solution channels and caverns in beds of gypsum and anhydrite. In most places the aquifer exists under water table conditions, but it is also artesian where overlain by the Dog Creek Shale. Saturated thickness of the aquifer approaches 300 feet in its northern extent, and is generally less in the Region B area. Well yields vary considerably from one location to another due to the nature of solution channels. It is common for dry holes to be found adjacent to wells of moderate to high yield. The average well yield is 400 gpm.

The primary source of recharge to the Blaine is precipitation that falls on the High Plains Escarpment to the west and the Blaine outcrop area. The solution openings and fractures in the gypsum provide access for water to percolate downward. The Blaine may also receive some recharge from the overlying Dog Creek Shale.

Water in the Blaine generally moves eastward through the solution channels, dissolving mineral deposits along the way, and discharging to low topographic areas. The dissolved solids concentrations in the aquifer increase with depth and generally range from 1,000 to over 10,000 mg/l. Due to the high mineral content, the TWDB has limited the extent of the Blaine to areas with water less than 10,000 mg/l of dissolved solids.

Natural salt springs and seeps from the Blaine contribute to increased salinity of surface water. Due to the high mineral content the Blaine has been used primarily for irrigation of salt tolerant crops.

Trinity Group

The Trinity Group consists of three formations, the Travis Peak, Glen Rose and Paluxy. In the northern part of its extent, the Glen Rose thins out and the Travis Peak and Paluxy coalesce into a single geologic unit known as the Antler Formation. In Region B, the Trinity Group outcrops in the eastern portion of Montague County. The thickness of the aquifer ranges from less than 10 feet to 600 feet. Water table conditions occur in outcrop area, while artesian conditions exist in the downdip formation. Well yields in the Trinity Group range from moderate to low. The effective recharge for the entire Trinity Aquifer as determined by TDWR is 1.5 percent of the mean annual precipitation over the outcrop area (TDWR, 1982).

Limited amounts of good quality water can be obtained from the Trinity in Montague County. Ground water is generally used for municipal, mining, irrigation and livestock purposes. Water level declines have been recorded in heavily pumped areas to the south and southeast of Montague County.

3.2.2 Groundwater Availability and Recharge

The average annual groundwater availability is the amount of water that could be reasonably developed from the aquifer. It is comprised of the annual effective recharge plus the amount of water that can be recovered annually from storage over a specified planning period without causing irreversible harm, such as subsidence or water quality deterioration.

As part of the 1997 State Water Plan, the TWDB evaluated the groundwater availability for the major and minor aquifers of the state. Previous publications and water well data were used to derive annual ground water availability. Effective recharge was determined by applying a percentage of the mean annual precipitation upon the aquifer's outcrop area. For the Seymour, the TWDB used a conservative estimate of 5 percent of the average annual precipitation for the entire Seymour formation. This percentage was generally based on the low flow analyses used in the ground water studies of Baylor and Jones counties (TDWR Report 238, 1979). In addition, an estimated annual amount recoverable from storage was determined based on 75 percent of the total storage for the planning period from 1974 through 2030. After 2030, it was assumed no water would be available from storage.

Reviews of previous ground water publications found a range of reportable recharge rates and availability estimates for the Seymour Aquifer. The Baylor study (TDWR, 1978) indicated an effective recharge rate of 10 percent of the average annual precipitation for the year 1969. However, ground water availability was limited in some areas due to thin saturated thickness and high loss to evapotranspiration. The Baylor study also did not include mining of ground water from storage due to the nature of the near surface aquifer (i.e., did not want to create abnormally low water levels. Most recently, a study by Woodward Clyde for the City of Vernon estimated the recharge to the Seymour in the Odell-Lockett area in Wilbarger County to be approximately 15 percent of the average rainfall (Woodward-Clyde, 1998).

This higher estimate of recharge appears to be limited to specific areas and cannot be applied over the regional aquifer. Also, it is unrealistic to expect that all aquifer recharge will be available for development. The TWDB estimate of 5 to 7 percent of the annual precipitation is a reasonable estimate of effective recharge for the Seymour, and is appropriate for regional water planning purposes. However, since the Seymour Aquifer is a near-surface unconfined aquifer and is sensitive to recharge and withdrawals, mining of the aquifer may adversely affect the water supply. Therefore, for this plan, the mining of storage is not included in the ground water availability estimates for the Seymour.

For the Blaine Gypsum formation, comparisons of declines of water levels and pumpage were used to estimate effective recharge. In Hardeman County, Maderak (TDWR, 1972) determined the effective recharge to the Blaine to be between 5 and 7 percent of the average annual precipitation. The TWDB used a conservative estimate of 5 percent for water availability planning. No recoverable storage from the Blaine was included in the availability estimates. For the Blaine, the ground water estimates include water with TDS up to 10,000 mg/l. For the other aquifers in the region, the availability estimates were limited to water containing less than 3,000 mg/l of dissolved solids.

The TWDB methodology for ground water availability for the Blaine Aquifer is appropriate for this planning effort. However, the Blaine Aquifer has a large amount of ground water with moderate to high salinity. As a result much of the water from this formation is not used in the region. The 1997 Water Plan includes water with moderate salinity in the availability numbers for irrigation, but is not appropriate for municipal use. Therefore, the ground water availability from the Blaine is broken down by TDS level. Based on historical water quality data, there is no water available for municipal purposes. Water with TDS levels between 1,000 and 3,000 is appropriate for irrigation, livestock, mining and some industrial uses. Water with TDS levels greater than 3,000 may be available with treatment or irrigation of salt tolerant crops.

The effective recharge for the Trinity Aquifer within the Brazos, Trinity and Red River basins was determined by the trough method (TDWR Report 238, 1979). Using this method, it was determined that approximately 1.5 percent of the annual precipitation over the outcrop area is available for development as effective recharge. In addition, the TWDB estimated that 1 million acre-feet of water could be withdrawn from artesian storage within the Trinity. However, much of the Trinity Group within Montague County is not artesian and the storage values may be less.

Since much of the Trinity Aquifer is artesian and the outcrop area is used to recharge the downdip portion of the aquifer, a direct application of effective recharge over the outcrop area is not appropriate to determine ground water availability. For this planning effort, the availability estimates determined by TWDB for the Trinity Aquifer will be used.

For the Seymour and Blaine aquifers, the recharge values used in the 1997 Water Plan were based on outcrop areas defined in 1979. Since 1979, the outcrop areas have been re-defined and there is a longer record of precipitation data available. As a result, the amount of groundwater that is available from these aquifers differs from the 1997 Water Plan. Groundwater availabilities for the Seymour and Blaine aquifers were re-calculated as 5 percent of the mean annual rainfall over the outcrop area, using the latest precipitation data and the most recent delineation of recharge areas. The availability estimates for the Trinity were taken directly from the 1997 Water Plan. A summary of ground water availability by aquifer and county is presented in Table 3-8. Table 3-9 shows the availability in the Blaine Aquifer by concentration of TDS.

Table 3-8: Ground Water Availability – Region B

County Name	Basin	Aquifer Name	Ground Water Availability (af/yr)	Effective Recharge Rate (in/yr)
Baylor	Brazos	Seymour	8,205	1.35
Baylor	Red	Seymour	1,485	1.35
Baylor	*Total*	*Seymour*	*9,690*	*1.35*
Clay	Red	Seymour	7,870	1.39
Cottle	Red	Seymour	8,410	1.11
Cottle	Red	Blaine	27,100	1.01
Foard	Red	Seymour	12,130	1.23
Foard	Red	Blaine	15,390	1.19
Hardeman	Red	Seymour	15,390	1.18
Hardeman	Red	Blaine	23,770	0.92
King	Red	Blaine	17,590	1.10
Montague	Red	Trinity	239	0.51
Montague	Trinity	Trinity	2,443	0.51
Montague	*Total*	*Trinity*	*2,682*	*0.51*
Wichita	Red	Seymour	13,920	1.38
Wilbarger	Red	Seymour	30,500	1.28

Table 3-9: Availability in Blaine Aquifer by TDS

County	Basin	Ground Water Availability (af/yr)			
TDS (mg/l):		*Total*	*1,000 - 3,000*	*3,000 - 10,000*	*>10,000*
Cottle	Red	27,100	6,494	18,153	2,453
Foard	Red	15,390	10,945	4,445	0
Hardeman	Red	23,770	13,601	10,169	0
King	Red	17,590	3,706	13,884	0

As shown on the above tables, there are large quantities of water available in the Seymour and Blaine aquifers, and limited quantities in the Trinity Aquifer. However, the water in the Blaine is unsuitable for municipal use without additional treatment, and only a portion is readily available for other uses. Water quality issues associated with the Seymour Aquifer (nitrates and TDS) also limit the usefulness of this resource. Historical use indicates that with the exception of Wilbarger County, much of the groundwater is not fully developed or not currently being used. A comparison of the 1997 historical use and groundwater availability estimates is shown on Table 3-10.

Table 3-10: Ground Water Historical Use

County	Aquifer	Availability (af/yr)	Historical Use-1997 (af/yr)
Baylor	Seymour	9,690	1,352
Clay	Seymour	7,870	921
Cottle	Seymour	8,410	22
Cottle	Blaine	27,100	2,517
Foard	Seymour	12,130	3,688
Foard	Blaine	15,390	23
Hardeman	Seymour	15,390	123
Hardeman	Blaine	23,770	3,901
King	Blaine	17,590	213
Montague	Trinity	2,682	419
Wichita	Seymour	13,920	2,631
Wilbarger	Seymour	30,500	23,344

3.2.3 Reliability of Local Supplies

Many of the local cities and communities in Region B rely on groundwater for all or a portion of their municipal supply. Those communities that use groundwater exclusively include the cities of Vernon, Seymour, Paducah, Saint Jo and Montague. The cities of Electra, Burkburnett and Chillicothe use a combination of groundwater and surface water. Also, several water supply corporations use groundwater to supply rural areas. Based on surveys of the water users in Region B, some of these users are experiencing lower water table elevations, nitrate contamination, and/or salt water intrusion of their groundwater supplies. Nitrate contamination is a particular concern in the Seymour Aquifer.

Two of the cities, Vernon and Electra, have recently conducted independent studies of their groundwater systems. The Vernon study (Woodward-Clyde, 1998) found that the City has an estimated reliable supply of 2.5 million gallons per day (MGD), which is about 2,800 acre-feet per year. In addition, there is approximately 0.5 MGD that is available from several older City wells. This supply has higher nitrate levels and historically has been used only for peak summer demands. The City plans to utilize these wells for manufacturing needs that do not have nitrate limits. The study for the City of Electra found that the system can sustain between 0.1 and 0.15 MGD without significant water table decline. This amount (112 acre-feet per year) was assumed available for future use. However, there are water quality issues with the groundwater (nitrates and TDS) that may preclude its use for municipal needs without additional treatment.

3.3 Inter-Basin Transfers and Inter-Region Transfers

There is only one known inter-basin transfer in Region B. This is from Lake Kickapoo in the Red River Basin to the City of Olney in the Brazos basin. The City of Olney has a contract with the City of Wichita Falls to provide 1 MGD of water during peak demands. Most years this additional supply is not used or minimally used.

The only surface water supply source located outside Region B is Greenbelt Lake. Water is supplied from Greenbelt Municipal and Industrial Water Authority to selected cities and communities in Hardeman and Foard Counties via a pipeline from Greenbelt Lake.

3.4 Allocation of Existing Supplies

3.4.1 Approach

TWDB has requested that existing water supply be allocated to water users by city and category (Appendix A Table 5). This includes a break down by county and river basin. This table represents a picture of where the existing water is being used today. If available, surface water allocations are based on current water rights, contracts and available yields, accounting for the most restraining limitation (e.g., reservoir yield or water treatment). Groundwater allocations are based on current developed well fields, accounting for aquifer limits. For categories or cities with no associated contracts or rights, the historical use data provided by TWDB was used. Where appropriate, the highest reported use over the past 10 years was used. Surface water use reported to TWDB for livestock watering was assumed supplied by on farm stock ponds.

Once the allocations were made, they were checked against source yields. Adjustments were made as needed. If a source's yield was less than the water rights, adjustments were made based on historical use and projected demands. If all future demands could be met by the source, then a hierarchy of water rights was not performed.

A similar approach was taken for groundwater. However, in lieu of water rights and contracts, the historical maximum use (past 10 years) and groundwater availability were considered. For the Cities of Vernon and Electra, who have recently had their groundwater supplies evaluated, the findings of these studies were used for long-term supply availability.

As a special case with mixed uses, the demands and water supply for Sheppard Airforce Base (SAFB) were accounted for separately. SAFB receives most of its water supply from the City of Wichita Falls. It's current contract does not specify a minimum or maximum amount, but it is expected that SAFB will use approximately 2,429 acre-feet per year of water over the planning

period. This amount is accounted for in the total available supply from the Wichita system shown on Table 3-11.

Table 3-11: Allocation of Existing Supplies – Region B

Basin Name	County Name	City Name	Source Name	Existing Supply (af/yr)						Comment
				2000	2010	2020	2030	2040	2050	
Red	Archer	Archer City	Wichita System	673	673	673	673	673	673	Long-term contract
Brazos	Archer	County-Other	Other Aquifer	30	30	30	30	30	30	80% of Historical Max Use (adjusted for aquifer limit)
Red	Archer	County-Other	Other Aquifer	107	107	107	107	107	107	80% of Historical Max Use (adjusted for aquifer limit)
Red	Archer	County-Other	Wichita System	1,009	1,009	1,009	1,009	1,009	1,009	Contracts
Trinity	Archer	County-Other	Other Aquifer	7	7	7	7	7	7	80% of Historical Max Use (adjusted for aquifer limit)
Red	Archer	Holliday	Wichita System	230	225	215	207	199	191	No Contract Amt, Supply = Demand
Red	Archer	Irrigation (On-Farm)	Kemp	4,891	4,048	3,765	3,483	3,201	3,100	5% Of Available Irrigation Releases
Red	Archer	Lakeside City	Wichita System	392	392	392	392	392	392	Contract, No Expiration Date
Brazos	Archer	Livestock	Other Aquifer	11	11	11	11	11	11	80% of Historical Max Use (adjusted for aquifer limit)
Brazos	Archer	Livestock	Local Supply	122	122	122	122	122	122	Historical Max Use, Stock Tanks
Red	Archer	Livestock	Other Aquifer	182	182	182	182	182	182	80% of Historical Max Use (adjusted for aquifer limit)
Red	Archer	Livestock	Local Supply	2,051	2,051	2,051	2,051	2,051	2,051	Historical Max Use, Stock Tanks
Trinity	Archer	Livestock	Other Aquifer	24	24	24	24	24	24	80% of Historical Max Use (adjusted for aquifer limit)
Trinity	Archer	Livestock	Local Supply	266	266	266	266	266	266	Historical Max Use, Stock Tanks
Red	Archer	Mining	Other Aquifer	1	1	1	1	1	1	Historical Max Use
Red	Archer	Scotland	Wichita System	280	280	280	280	280	280	Contract, No Expiration Date
Red	Archer	Steam Electric Power	Kemp	14,000	14,000	14,000	14,000	14,000	14,000	New Contract for proposed plant
Brazos	Baylor	County-Other	Seymour	189	189	189	189	189	189	Historical Max Use- 10 Yrs, Baylor WSC Max Use = 220 (Red & Brazos)
Red	Baylor	County-Other	Seymour	30	30	30	30	30	30	Historical Max Use- 10 Yrs

Table 3-11: Allocation of Existing Supplies – Region B (continued)

Basin Name	County Name	City Name	Source Name	Existing Supply (af/yr)						Comment
				2000	2010	2020	2030	2040	2050	
Brazos	Baylor	Irrigation (On-Farm)	Seymour	1,837	1,837	1,837	1,837	1,837	1,837	Historical Max Use
Red	Baylor	Irrigation (On-Farm)	Seymour	375	375	375	375	375	375	Historical Max Use
Brazos	Baylor	Livestock	Seymour	41	41	41	41	41	41	Historical Max Use
Brazos	Baylor	Livestock	Local Supply	373	373	373	373	373	373	Historical Max Use, Stock Tanks
Red	Baylor	Livestock	Seymour	69	69	69	69	69	69	Historical Max Use
Red	Baylor	Livestock	Local Supply	621	621	621	621	621	621	Historical Max Use, Stock Tanks
Brazos	Baylor	Mining	Seymour	47	47	47	47	47	47	Historical Max Use
Brazos	Baylor	Seymour	Seymour	747	747	747	747	747	747	Historical Max Use
Red	Clay	Byers	Seymour	89	89	89	89	89	89	Historical Max Use
Red	Clay	County-Other	Wichita System	1,766	1,766	1,766	1,766	1,766	1,766	Contracts with Arrowhead Prop/RRA/Dean Dale
Red	Clay	County-Other	Seymour	55	55	55	55	55	55	Historical Max Use
Red	Clay	County-Other	Other Aquifer	300	300	300	300	300	300	Historical Max Use
Trinity	Clay	County-Other	Other Aquifer	72	72	72	72	72	72	Historical Max Use
Red	Clay	Henrietta	Wichita System	600	600	600	600	600	600	Estimated amount from Lake Arrowhead for shortfall of superior run of river right
Red	Clay	Henrietta	Local Supply Little Wichita River	960	960	960	960	960	960	Run of River Right – Little Wichita (difference between right amount and Arrowhead make-up)
Red	Clay	Irrigation (On-Farm)	Other Aquifer	250	250	250	250	250	250	Historical Max Use – Split Between Seymour & Other
Red	Clay	Irrigation (On-Farm)	Seymour	287	287	287	287	287	287	Historical Max Use – Split Between Seymour & Other

Table 3-11: Allocation of Existing Supplies – Region B (continued)

Basin Name	County Name	City Name	Source Name	Existing Supply (af/yr)						Comment
				2000	2010	2020	2030	2040	2050	
Red	Clay	Irrigation (On-Farm)	Kemp	4,754	3,911	3,628	3,346	3,064	2,963	5% Of Available Irrigation Releases
Red	Clay	Livestock	Local Supply	1,747	1,747	1,747	1,747	1,747	1,747	Historical Max Use, Stock Tanks
Red	Clay	Livestock	Seymour	100	100	100	100	100	100	Historical Max Use
Red	Clay	Livestock	Other Aquifer	94	94	94	94	94	94	Historical Max Use
Trinity	Clay	Livestock	Local Supply	225	225	225	225	225	225	Historical Max Use, Stock Tanks
Trinity	Clay	Livestock	Other Aquifer	25	25	25	25	25	25	Historical Max Use
Red	Clay	Mining	Seymour	502	502	502	502	502	502	Historical Max Use
Trinity	Clay	Mining	Other Aquifer	6	6	6	6	6	6	Historical Max Use
Red	Clay	Petrolia	Local Supply	0	0	0	0	0	0	Petrolia City Lake (assume no long-term reliable supply)
Red	Clay	Petrolia	Seymour	70	70	70	70	70	70	Historical Use
Red	Cottle	County-Other	Other Aquifer	155	155	155	155	155	155	Historical Max Use
Red	Cottle	County-Other	Local Supply	15	15	15	15	15	15	Historical Max Use
Red	Cottle	Irrigation (On-Farm)	Blaine	4,525	4,525	4,525	4,525	4,525	4,525	Historical Max Use
Red	Cottle	Irrigation (On-Farm)	Other Aquifer	0	0	0	0	0	0	Historical Max Use
Red	Cottle	Irrigation (On-Farm)	Local Supply	46	46	46	46	46	46	Historical Max Use
Red	Cottle	Livestock	Seymour	47	47	47	47	47	47	Historical Max Use
Red	Cottle	Livestock	Local Supply	429	429	429	429	429	429	Historical Max Use, Stock Tanks
Red	Cottle	Mining	Local Supply	23	23	23	23	23	23	Historical Max Use
Red	Cottle	Paducah	Other Aquifer	442	442	442	442	442	442	Historical Max Use - 10 Years
Red	Foard	County-Other	Greenbelt	80	75	73	72	71	65	No Contract Amt, Supply = Demand
Red	Foard	County-Other	Seymour	113	113	113	113	113	113	Historical Max Use
Red	Foard	Crowell	Greenbelt	313	294	275	257	243	230	No Contract Amt, Supply = Demand

Table 3-11: Allocation of Existing Supplies – Region B (continued)

Basin Name	County Name	City Name	Source Name	Existing Supply (af/yr)						Comment
				2000	2010	2020	2030	2040	2050	
Red	Foard	Irrigation (On-Farm)	Seymour	5,200	5,200	5,200	5,200	5,200	5,200	Historical Max Use
Red	Foard	Irrigation (On-Farm)	Blaine	23	23	23	23	23	23	Historical Max Use
Red	Foard	Irrigation (On-Farm)	Seymour	32	32	32	32	32	32	Historical Max Use
Red	Foard	Livestock	Local Supply	291	291	291	291	291	291	Historical Max Use, Stock Tanks
Red	Foard	Mining	Seymour	23	23	23	23	23	23	Historical Max Use
Red	Hardeman	Chillicothe	Greenbelt	61	58	56	56	55	55	Assume Greenbelt Meets 50% Of Demands
Red	Hardeman	Chillicothe	Seymour	80	80	80	80	80	80	Current GW Use
Red	Hardeman	County-Other	Greenbelt	168	168	168	168	168	168	No Contract Amt, Supply = 1996 use
Red	Hardeman	County-Other	Seymour	116	116	116	116	116	116	Historical Max Use
Red	Hardeman	Irrigation (On-Farm)	Pauline/Groesbeck	145	145	145	145	145	145	Historical Max Use, ROR Groesbeck Creek and Lake Pauline
Red	Hardeman	Irrigation (On-Farm)	Blaine	7,000	7,000	7,000	7,000	7,000	7,000	Historical Max Use
Red	Hardeman	Irrigation (On-Farm)	Seymour	150	150	150	150	150	150	Historical Max Use
Red	Hardeman	Livestock	Local Supply	298	298	298	298	298	298	Historical Max Use, Stock Tanks
Red	Hardeman	Livestock	Seymour	198	198	198	198	198	198	Historical Max Use
Red	Hardeman	Manufacturing	Greenbelt	347	374	398	424	452	480	No Contract Amt, Supply = Demand
Red	Hardeman	Mining	Local Supply	7	7	7	7	7	7	Historical Max Use
Red	Hardeman	Quanah	Greenbelt	614	572	532	514	502	492	No Contract Amt, Supply = Demand
Red	Hardeman	Steam Electric Power	Pauline/Groesbeck	1,655	1,601	1,548	1,494	1,440	1,387	Pauline/Groesbeck Creek Yield minus Irrigation use
Brazos	King	County-Other	Other Aquifer	4	4	4	4	4	4	Historical Max Use

Table 3-11: Allocation of Existing Supplies – Region B (continued)

Basin Name	County Name	City Name	Source Name	Existing Supply (af/yr)						Comment
				2000	2010	2020	2030	2040	2050	
Red	King	County-Other	Blaine	161	161	161	161	161	161	Historical Max Use
Red	King	Guthrie	Other Aquifer	86	86	86	86	86	86	Historical Max- Supplied By RRA From Dickens Co
Red	King	Irrigation (On-Farm)	Blaine	750	750	750	750	750	750	Historical Max Use
Brazos	King	Livestock	Local Supply	255	255	255	255	255	255	Historical Max Use, Stock Tanks
Brazos	King	Livestock	Other Aquifer	28	28	28	28	28	28	Historical Max Use
Red	King	Livestock	Blaine	49	49	49	49	49	49	Historical Max Use
Red	King	Livestock	Local Supply	439	439	439	439	439	439	Historical Max Use, Stock Tanks
Trinity	Montague	Bowie	Amon G. Carter	2,457	2,420	2,382	2,345	2,307	2,270	Yield Of Reservoir- Sales
Red	Montague	County-Other	Nocona	38	38	38	38	38	38	Historical Max Use
Red	Montague	County-Other	Other Aquifer	416	416	416	416	416	416	Historical Max Use
Red	Montague	County-Other	Trinity	0	0	0	0	0	0	Historical Max Use
Trinity	Montague	County-Other	Other Aquifer	300	300	300	300	300	300	Historical Max Use
Trinity	Montague	County-Other	Amon G. Carter	143	143	143	143	143	143	Historical Max Use
Trinity	Montague	County-Other	Trinity	200	200	200	200	200	200	Historical Max Use
Red	Montague	Irrigation (On-Farm)	Other Aquifer	19	19	19	19	19	19	Historical Max Use
Red	Montague	Irrigation (On-Farm)	Nocona	100	100	100	100	100	100	Water Right 4879
Red	Montague	Irrigation (On-Farm)	Local Supply	100	100	100	100	100	100	Run Of River Rights
Trinity	Montague	Irrigation (On-Farm)	Trinity	179	179	179	179	179	179	Historical Max Use
Trinity	Montague	Irrigation (On-Farm)	Local Supply	133	133	133	133	133	133	Historical Max Use – surface water
Red	Montague	Livestock	Other Aquifer	106	106	106	106	106	106	Historical Max Use
Red	Montague	Livestock	Local Supply	951	951	951	951	951	951	Historical Max Use, Stock Tanks

Table 3-11: Allocation of Existing Supplies – Region B (continued)

Basin Name	County Name	City Name	Source Name	Existing Supply (af/yr)						Comment
				2000	2010	2020	2030	2040	2050	
Trinity	Montague	Livestock	Trinity	79	79	79	79	79	79	Historical Max Use
Trinity	Montague	Livestock	Local Supply	714	714	714	714	714	714	Historical Max Use, Stock Tanks
Red	Montague	Manufacturing	Nocona	10	10	12	15	19	24	Historical Max Use/Future Demand
Red	Montague	Mining	Local Supply	313	313	313	313	313	313	Run Of River Right, Hist Max
Red	Montague	Mining	Other Aquifer	310	310	310	310	310	310	Historical Max Use
Trinity	Montague	Mining	Trinity	18	18	18	18	18	18	Historical Max Use
Red	Montague	Montague	Other Aquifer	38	38	38	38	38	38	Historical Max Use
Red	Montague	Nocona	Nocona	1,112	1,112	1,110	1,107	1,103	1,098	Remainder of water right
Red	Montague	Saint Jo	Trinity	47	47	47	47	47	47	
Trinity	Montague	Saint Jo	Trinity	139	139	139	139	139	139	Historical Max Use
Red	Wichita	Burkburnett	Seymour	916	916	916	916	916	916	Historical Max- 10 Yrs
Red	Wichita	Burkburnett	Wichita System	2,795	2,795	2,795	2,795	2,795	2,795	Contract
Red	Wichita	County-Other	Wichita System	1,682	1,682	1,682	1,682	1,682	1,682	WSC Contracts In Wichita Co.
Red	Wichita	County-Other	Seymour	851	851	851	851	851	851	Historical Max- 10 Yrs
Red	Wichita	County-Other	N.F. Buffalo Creek	340	340	340	340	340	340	Iowa Park Sales To Wichita Co. WSC
Red	Wichita	Electra	Electra City Lake	440	440	440	440	440	440	Yield Study
Red	Wichita	Electra	Seymour	112	112	112	112	112	112	1998 Study
Red	Wichita	Iowa Park	N.F. Buffalo Creek	500	500	500	500	500	500	Water Right-Minus County Sales
Red	Wichita	Iowa Park	Local Supply	250	250	250	250	250	250	Half - Lake Iowa Park Water Right
Red	Wichita	Iowa Park	Wichita System	2,036	2,036	2,036	2,036	2,036	2,036	Contract, less manufacturing sales
Red	Wichita	Irrigation (On-Farm)	Kemp	71,354	67,972	63,686	59,402	55,126	54,109	90% Of Available Irrigation Releases
Red	Wichita	Irrigation (On-Farm)	Seymour	712	712	712	712	712	712	Historical Max Use
Red	Wichita	Irrigation (On-Farm)	Other Aquifer	179	179	179	179	179	179	Historical Max Use

Table 3-11: Allocation of Existing Supplies – Region B (continued)

Basin Name	County Name	City Name	Source Name	Existing Supply (af/yr)						Comment
				2000	2010	2020	2030	2040	2050	
Red	Wichita	Livestock	Seymour	78	78	78	78	78	78	Historical Max Use
Red	Wichita	Livestock	Local Supply	700	700	700	700	700	700	Historical Max Use, Stock Tanks
Red	Wichita	Manufacturing	Wichita System	1,836	1,997	2,095	2,185	2,297	2,384	Demands – Existing contracts
Red	Wichita	Manufacturing	Seymour	216	216	216	216	216	216	Historical Max Use
Red	Wichita	Mining	Seymour	594	594	594	594	594	594	Historical Max Use
Red	Wichita	Pleasant Valley	Wichita System	101	100	95	93	91	90	No Contract Amount, Supply = Demands
Red	Wichita	Steam Electric Power	Wichita System	360	360	360	360	360	360	Historical Max - 10 Yrs
Red	Wichita	Wichita Falls	Wichita System	28,118	27,893	27,689	27,489	27,266	27,068	Remainder of System Yield[1]
Red	Wilbarger	County-Other	Seymour	676	676	676	676	676	676	1997 Usage, 10-Yr Max = 2,324 (1988)
Red	Wilbarger	County-Other	Electra City Lake	30	30	30	30	30	30	Municipal Sales From Electra to Harrolds WSC
Red	Wilbarger	Irrigation (On-Farm)	Seymour	23,989	23,989	23,989	23,989	23,989	23,989	Historical Max Use, Adjusted for availability limit
Red	Wilbarger	Livestock	Seymour	180	180	180	180	180	180	Historical Max Use
Red	Wilbarger	Livestock	Local Supply	1,617	1,617	1,617	1,617	1,617	1,617	Historical Max Use, Stock Tanks
Red	Wilbarger	Manufacturing	Seymour	685	685	685	685	685	685	Historical Max Use
Red	Wilbarger	Mining	Seymour	10	10	10	10	10	10	Historical Use
Red	Wilbarger	Mining	Local Supply	30	30	30	30	30	30	Run of River Right - 5127
Red	Wilbarger	Steam Electric Power	Kemp	20,000	20,000	20,000	20,000	20,000	20,000	Water Right (Assume Contract Renewed)
Red	Wilbarger	Vemon	Seymour	2,640	2,640	2,640	2,640	2,640	2,640	Long-Term Average-Municipal (recent study)
Brazos	Young	Olney	Wichita System	1,121	1,121	1,121	1,121	1,121	1,121	Water Right
Brazos	Young	Olney	Local Supply	910	910	910	910	910	910	Lakes Olney/Cooper – reservoir yield

1. The Wichita System yield was reduced by 2,429 acre-feet per year to account for demands by Sheppard AFB.

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